

AMENDMENTS TO THE SPECIFICATION

Please replace the paragraph beginning at page 2, line 6, and insert the following rewritten paragraph:

It is necessary for the oxidant gas to be brought into contact with the cathode 203 effectively. To this end, many grooves ~~208...~~208 are provided in the face 207a of the second separator 207, and by the grooves ~~208...~~208 being covered when the diffusion layer 205 is disposed on the face 207a of the second separator 207, second flow passages (not shown) constituting oxidant gas flow passages are formed.

Please replace the paragraph beginning at page 2, line 13, and insert the following rewritten paragraph:

And in the first separator 206, many cooling water passage grooves ~~209...~~209 are provided in the reverse face 206b to the face 206a, and many cooling water passage grooves (not shown) are provided in the reverse face 207b to the face 207a in the second separator 207. By the first and second separators 206, 207 being brought face to face, the cooling water passage grooves ~~209...~~209 of each are brought together to form cooling water passages (not shown).

Please replace the paragraph beginning at page 6, line 12, and insert the following rewritten paragraph:

In a first aspect, this invention provides a fuel cell separator for sandwiching from both sides via diffusion layers an anode and a cathode set against an electrolyte film, made of a mixture of a thermoplastic resin selected from among ethylene / vinyl acetate copolymers and ethylene / ethyl acrylate copolymers and-a at least one type of carbon particle selected from Ketjen black, graphite and acetylene black.

Please replace the paragraph beginning at page 7, line 16, and insert the following rewritten paragraph:

The reasons for setting the proportion of the thermoplastic resin to 14 to 20wt% are as follows. That is, when the thermoplastic resin content is less than 14wt%, it is difficult to secure enough elasticity, i.e. sealing characteristic, of the contact faces of the separator, because the thermoplastic resin content is too low. When, on the other hand, the thermoplastic resin content exceeds 20wt%, the amount of the carbon particle included in the separator is too low, and it is difficult to secure conductivity of the separator adequately. Accordingly, the thermoplastic resin content was set to 14 to 20wt% to secure sealing characteristic of the separator and adequately secure electrical conductivity of the separator.

Please replace the paragraph beginning at page 8, line 13, and insert the following rewritten paragraph:

If on the other hand the Ketjen black content exceeds 20wt%, kneading becomes difficult because the Ketjen black content is too large. Although it is conceivable to make kneading possible by adding a solvent, there is a risk of costs increasing as a result of using a solvent. Furthermore, even if a solvent is added and kneading is completed successfully, the fluidity of the knead including the Ketjen black is poor and, for example, at the time of molding it is difficult to obtain the predetermined shape.

Please replace the paragraph beginning at page 8, line 21, and insert the following rewritten paragraph:

Accordingly, the Ketjen black content was set to 3 to 20wt% to secure adequate electrical conductivity of the separator and ~~also achieve facilitation of to~~ facilitate kneading and ~~secure moldability well~~ molding.

Please replace the paragraph beginning at page 8, line 27, and insert the following rewritten paragraph:

By glass fiber or carbon fiber being mixed into the mixture, the rigidity of the separator is raised. The reasons for setting the glass fiber or carbon fiber content to 2.5 to 10wt% are that when the glass fiber or carbon fiber content is less than 2.5wt%, it is difficult to raise the rigidity of the separator because the glass fiber or carbon fiber content is too low. When, on the other hand, the glass fiber or carbon fiber content exceeds 10wt%, the glass fiber or carbon fiber content is too large and

it is difficult to disperse the glass fiber or carbon fiber uniformly in the mixture and extrusion-molding and pressing of the mixture become problematic. Accordingly, the glass fiber or carbon fiber content was set to 2.5 to 10wt%, to ensure a sufficient glass fiber or carbon fiber content and raise the rigidity of the separator, and to disperse the glass fiber or carbon fiber uniformly and obtain a mixture with good moldability and thereby raise productivity.

Please replace the paragraph beginning at page 9, line 16, and insert the following rewritten paragraph:

In a second aspect, the invention provides a method for manufacturing a fuel cell separator, including: a step of selecting a thermoplastic resin from among ethylene / vinyl acetate copolymers and ethylene / ethyl acrylate copolymers and selecting at least one type of carbon particles from Ketjen black, graphite and acetylene black; a step of obtaining a mixture by mixing the selected thermoplastic resin and carbon particles; a step of obtaining a sheet material by extrusion-molding the mixture with an extruder; a step of forming gas flow passage grooves in the surface of the sheet material by pressing ~~it~~the sheet material; and a step of obtaining fuel cell separators by cutting the sheet material with the gas flow passages formed ~~in it~~therein to a predetermined shape.

Please replace the paragraph beginning at page 10, line 2, and insert the following rewritten paragraph:

With the mixture in the form of a sheet material, gas passage grooves are press-formed in ~~its~~ the sheet material surface and then the sheet material is cut to a predetermined shape to obtain separators. By press-forming the gas passage grooves into the material in sheet form in this way it is possible to form the gas passage grooves continuously with good efficiency and to raise the productivity of the separator.

Please replace the paragraph beginning at page 10, line 9, and insert the following rewritten paragraph:

In a third aspect, the invention provides a fuel cell separator for sandwiching from both sides via diffusion layers an anode and a cathode set against an electrolyte film, ~~characterized in that it~~ wherein the separator is made of a mixture including 10 to 34wt% polyphenylene sulfide, 65 to 80wt% graphite, and 1 to 10wt% Ketjen black.

Please replace the paragraph beginning at page 11, line 1, and insert the following rewritten paragraph:

The reasons for setting the polyphenylene sulfide content to 10 to 34 wt% are as follows. That is, when the polyphenylene sulfide content is less than 10 wt%, the polyphenylene sulfide content is too low and it becomes difficult to secure moldability of the separator and elasticity of the separator, i.e. sealing characteristic. Also, when the content is less than 10wt%, it is difficult to secure heat-resistance of the

separator and to make the separator it work as a bonding agent. When on the other hand the polyphenylene sulfide content exceeds 34wt%, the graphite content in the separator is too small and it is difficult to secure adequate electrical conductivity of the separator. Accordingly, the polyphenylene sulfide content was set to 10 to 34wt% to secure moldability, sealing characteristic and heat-resistance of the separator and to secure a sufficient electrical conductivity.

Please replace the paragraph beginning at page 11, line 15, and insert the following rewritten paragraph:

Also, by including 65 to 80wt% of graphite in the separator, ~~its~~the electrical conductivity of the separator was raised.

Please replace the paragraph beginning at page 12, line 9, and insert the following rewritten paragraph:

The reasons for setting the Ketjen black content to 1 to 10 wt% are as follows. That is, when the Ketjen black content is less than 1 wt%, the Ketjen black content is too low, and there is a risk of not being possible to secure conductivity of the separator adequately. On the other hand, when the Ketjen black content exceeds 10 wt%, kneading becomes difficult because the Ketjen black content is too large. Although it is conceivable to make kneading possible by adding a solvent, there is a risk of costs increasing as a result of using a solvent. Furthermore, even if a solvent is added for kneading, the fluidity of the knead including the Ketjen black is relatively

poor and, for example, at the time of molding it is difficult to obtain the predetermined shape. Accordingly, the Ketjen black content was made 1 to 10 wt%, and the electrical conductivity was thereby raised still further.

Please replace the paragraph beginning at page 16, line 3, and insert the following rewritten paragraph:

The separator 18 is made up of a first separator 20 and a second separator 30, and has a cooling water passage formation face 20a of the first separator 20 and a bonding face 30a of the second separator 30 bonded together by, for example, vibration welding.

Please replace the paragraph beginning at page 16, line 8, and insert the following rewritten paragraph:

By the first and second separators 20, 30 being vibration-welded together like this, cooling water passage grooves ~~21...~~21 in the first separator 20 are covered by the second separator 30 and form cooling water passages ~~22...~~22 (see Fig. 4).

Please replace the paragraph beginning at page 16, line 12, and insert the following rewritten paragraph:

Cooling water supply openings 23a, 33a in the centers of the top ends of the first and second separators 20, 30 and cooling water discharge openings 23b, 33b in

the centers of the bottom ends of the first and second separators 20, 30 connect with these cooling water passages ~~22....~~22.

Please replace the paragraph beginning at page 16, line 17, and insert the following rewritten paragraph:

The first separator 20 has fuel gas passage grooves ~~24....~~24 (see Fig. 2) on a fuel gas passage formation face (contact face) 20b₁ and by the anode diffusion layer 15 being placed on the fuel gas passage formation face 20b the anode diffusion layer 15 covers the fuel gas passage grooves ~~24....~~24 and forms fuel gas passages ~~25....~~25 (see Fig. 4).

Please replace the paragraph beginning at page 16, line 23, and insert the following rewritten paragraph:

Fuel gas supply openings 26a, 36a in the left sides of the top ends of the first and second separators 20, 30 and fuel gas discharge openings 26b, 36b in the right sides of the bottom ends of the first and second separators 20, 30 are connected to these fuel gas passages ~~25....~~25.

Please replace the paragraph beginning at page 17, line 1, and insert the following rewritten paragraph:

The second separator 30 has oxidant gas passage grooves ~~37...~~37 in an oxidant gas passage formation face (contact face) 30b, and by the cathode diffusion layer 16 being placed on the oxidant gas passage formation face 30b the cathode diffusion layer 16 covers the oxidant gas passage grooves ~~37...~~37 and forms oxidant gas passages ~~38...~~38 (see Fig. 4).

Please replace the paragraph beginning at page 17, line 7, and insert the following rewritten paragraph:

Oxidant gas supply openings 29a, 39a in the right sides of the top ends of the first and second separators 20, 30 and oxidant gas discharge openings 29b, 39b in the left sides of the bottom ends of the first and second separators 20, 30 are connected to the oxidant gas passages ~~38...~~38.

Please replace the paragraph beginning at page 19, line 27, and insert the following rewritten paragraph:

If, on the other hand, the Ketjen black content exceeds 20wt%, kneading becomes difficult because the Ketjen black content is too large. Although it is conceivable to make kneading possible by adding a solvent, there is a risk of costs increasing as a result of using a solvent.

Please replace the paragraph beginning at page 20, line 5, and insert the

following rewritten paragraph:

Furthermore, even if a solvent is added and kneading is completed successfully, the fluidity of the knead including the Ketjen black is poor and, for example, at the time of molding it is difficult to obtain the predetermined shape.

Please replace the paragraph beginning at page 20, line 13, and insert the following rewritten paragraph:

Next, referring to Fig. 2, the first separator 20 is a member formed in a substantially rectangular shape (see Fig. 1) , and has many cooling water passage grooves ~~21...~~21 in a cooling water passage formation face 20a and has many fuel gas passage grooves ~~24...~~24 in a fuel gas passage formation face (contact face) 20b.

Please replace the paragraph beginning at page 22, line 10, and insert the following rewritten paragraph:

By the anode diffusion layer 15 being brought together with the fuel gas passage formation face 20b, fuel gas passages ~~25...~~25 are formed by the fuel gas passage grooves ~~24...~~24 and the anode diffusion layer 15.

Please replace the paragraph beginning at page 23, line 2, and insert the following rewritten paragraph:

And, as a result of the cathode diffusion layer 16 being brought together with the oxidant gas passage formation face 30b, by the oxidant gas passage grooves ~~37...~~37 and the cathode diffusion layer 16 the oxidant gas passages ~~38...~~38 are formed.

Please replace the paragraph beginning at page 25, line 9, and insert the following rewritten paragraph:

The cooled molding 53 is cut to a predetermined length with a cutter 57 of a cutting machine 56, and the cut pellets ~~58...~~58 are stocked in a stock tray 59.

Please replace the paragraph beginning at page 25, line 15, and insert the following rewritten paragraph:

The pellets ~~58...~~58 obtained in the previous step are fed into a hopper 61 of a second extrusion-molding machine 60 as shown with an arrow, and the pellets ~~58...~~58 are extrusion-molded by the second extrusion-molding machine 60. The extrusion-molded moldings 62 are rolled with rollers 63 to form a band-shaped sheet 64.

Please replace the paragraph beginning at page 25, line 23, and insert the following rewritten paragraph:

The upper press die 66 has a press face 66a facing a second side 64b of the band-shaped sheet 64, and tongues and grooves (not shown) in this press face 66a. The tongues and grooves in the press face 66a are for press-forming the fuel gas passage grooves ~~24...~~24 (see Fig. 4) in the second side 64b of the band-shaped sheet 64.

Please replace the paragraph beginning at page 26, line 2, and insert the following rewritten paragraph:

The lower press die 67 has a press face 67a facing a first side 64a of the sheet 64, and has tongues and grooves (not shown) in this press face 67a. These tongues and grooves in the press face 67a are for press-forming the cooling water passage grooves ~~21...~~21 (see Fig. 4) in the first side 64a of the band-shaped sheet 64.

Please replace the paragraph beginning at page 26, line 8, and insert the following rewritten paragraph:

The upper and lower press dies 66, 67 are disposed at a press starting position P1, both sides 64a, 64b of the band-shaped sheet 64 are pressed with the upper and lower press dies 66, 67, and with this state being maintained the upper and lower press dies 66, 67 are moved as shown by the ~~arrows a, b~~arrows a, b at the extrusion speed of the band-shaped sheet 64.

Please replace the paragraph beginning at page 26, line 14, and insert the following rewritten paragraph:

Thus, cooling water passage grooves ~~21...~~21 are press-formed in the first side 64a of the band-shaped sheet 64, i.e. the side corresponding to the cooling water passage formation face 20a (see Fig. 4), and fuel gas passage grooves ~~24...~~24 are press-formed in the second side 64b of the band-shaped sheet 64, i.e. the side corresponding to the fuel gas passage formation face 20b (see Fig. 4), whereby the band-shaped sheet 64 is formed into a separator starting material 68.

Please replace the paragraph beginning at page 27, line 6, and insert the following rewritten paragraph:

By the steps described above being repeated in turn, the cooling water passage grooves ~~21...~~21 and fuel gas passage grooves ~~24...~~24 are press-formed in the sides 64a, 64b of the band-shaped sheet 64.

Please replace the paragraph beginning at page 27, line 14, and insert the following rewritten paragraph:

By a plurality of each of the upper and lower press dies 66, 67 being provided, cooling water passage grooves ~~21...~~21 and fuel gas passage grooves ~~24...~~24 (see Fig. 4) can be press-formed continuously in the sides 64a, 64b of the band-shaped sheet 64.

Please replace the paragraph beginning at page 27, line 26, and insert the following rewritten paragraph:

Thus, as well as the cooling water passage grooves ~~21...~~21 and the fuel gas passage grooves ~~24...~~24 being formed in the sides 64a, 64b of the band-shaped sheet 64 with the upper and lower press dies 66 and 67, the cooling water supply opening 23a and the gas supply openings 26a, 29a and the cooling water discharge opening 23b and the gas discharge openings 26b, 29b shown in Fig. 1 are formed at the same time.

Please replace the paragraph beginning at page 28, line 9, and insert the following rewritten paragraph:

By a cutter 71 of this cutter device 70 being lowered as shown by the arrow i, the separator starting material 68 is cut to a predetermined dimension and first separators ~~20...~~20 are obtained. This ends the process of manufacturing the first separator 20.

Please replace the paragraph beginning at page 28, line 14, and insert the following rewritten paragraph:

Thus, in this method for manufacturing a fuel cell separator according to the invention, the cooling water passage grooves ~~21...~~21 and the fuel gas passage

grooves ~~24...~~24 are press-formed in the sides 64a, 64b of the mixture 50 in the form of a band-shaped sheet 64, and then the sheet 64 is cut to a predetermined dimension to obtain first separators 20.

Please replace the paragraph beginning at page 28, line 20, and insert the following rewritten paragraph:

By the cooling water passage grooves ~~21...~~21 and the fuel gas passage grooves ~~24...~~24 being press-formed in the sheet 64 state, the cooling water passage grooves ~~21...~~21 and the fuel gas passage grooves ~~24...~~24 can be molded continuously with good efficiency and the productivity of the first separator 20 can be raised.

Please replace the paragraph beginning at page 29, line 2, and insert the following rewritten paragraph:

However, the second separator 30 does not have the cooling water passage grooves ~~21...~~21 (see Fig. 4) like the first separator 20, and has a flat bonding face 30a. Because of this, the lower press die 67 shown in Fig. 7 does not need to have tongues and grooves for press-forming cooling water passage grooves ~~21...~~21 in the first side of the band-shaped sheet 64 in its face facing the first side of the band-shaped sheet 64.

Please replace the paragraph beginning at page 31, line 14, and insert the

following rewritten paragraph:

First, reference will be made to ~~Fig. 1~~Fig. 8, which is an exploded perspective view of a fuel cell with a fuel cell separator according to the second embodiment of the invention.

Please replace the paragraph beginning at page 37, line 10, and insert the following rewritten paragraph:

Next, referring to Fig. 9, the first separator 120 is a member formed in a substantially rectangular shape (see Fig. 8), and has many cooling water passage grooves ~~21...~~21 in a cooling water passage formation face 20a and has many fuel gas passage grooves ~~24...~~24 in a fuel gas passage formation face 20b.

Please replace the paragraph beginning at page 37, line 19, and insert the following rewritten paragraph:

Because the elastic modulus of the chopped carbon fiber included in the first separator 120 is high, when the chopped carbon fiber content is too large, chopped carbon fiber cannot get into the ribs ~~140...~~140 forming the cooling water passage grooves ~~21...~~21 or into the ribs ~~141...~~141 forming the fuel gas passage grooves ~~24...~~24, and separation of the chopped carbon fiber and the polyphenylene sulfide tends to occur.

Please replace the paragraph beginning at page 37, line 26, and insert the following rewritten paragraph:

Consequently, there is a risk of the ribs ~~140...~~, ~~141...~~ 140, 141 having a higher polyphenylene sulfide content compared to other parts, and not being able to exhibit their proper performance.

Please replace the paragraph beginning at page 38, line 2, and insert the following rewritten paragraph:

Accordingly, the chopped carbon fiber content was made 5 to 15wt%. In this way, the chopped carbon fiber is made to enter into the ribs ~~140...~~, ~~141...~~ 140, 141 well and the ribs ~~140...~~, ~~141...~~ 140, 141 are formed well.

Please replace the paragraph beginning at page 38, line 6, and insert the following rewritten paragraph:

As shown in Fig. 10, the second separator 130 is a member formed in a substantially rectangular shape as shown in Fig. 8, and has a bonding face 30a formed flat and has many oxidant gas passage grooves ~~37...~~ 37 in an oxidant gas passage formation face (contact face) 30b.

Please replace the paragraph beginning at page 38, line 16, and insert the following rewritten paragraph:

Like the first separator 120, in the second separator 130 also, because the chopped carbon fiber content is kept to 5 to 15 wt%, the chopped carbon fiber is made to enter into the ribs ~~442...~~142 well and the ribs ~~442...~~142 are formed well.

Please replace the paragraph beginning at page 38, line 27, and insert the following rewritten paragraph:

By the anode diffusion layer 15 being set against the fuel gas passage formation face 20b, fuel gas passages ~~25...~~25 are formed by the fuel gas passage grooves ~~24...~~24 and the anode diffusion layer 15.

Please replace the paragraph beginning at page 50, line 16, and insert the following rewritten paragraph:

Although in the foregoing first and second ~~embodi-ment~~embodiments examples were described wherein the first separators 20, 120 and the second separators 30, 130 were molded continuously by extrusion-molding and press-forming, the invention is not limited to this, and they can alternatively be molded by some other manufacturing method such as thermal pressing, injection-molding or transfer molding.